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Data solutions

: DATA SOLUTIONS - SATELLITE DATA PROVIDER - GAPMAP

- GRASP Multi-Angle Polarimeter (GAPMAP) is the **first-of-its-kind commercial space instrument** to characterize **particle air pollution** at **global** scale.
- Observing Earth scenes from space at different view angles and multiple states of polarization, GAPMAP provides **~100 times more data** than traditional radiometric space imagers.
- **GAPMAP data** undergoes seamless processing to provide products that can be used by customers to evaluate the air pollution in their communities – identifying whether those particles are likely produced by **industry** or swept in from **natural sources** such as wildfire smoke or desert dust.



Video: ADLER II GAPMAP mission launch simulation: <https://www.youtube.com/watch?v=D8gTvEyCF08&themeRefresh=1>

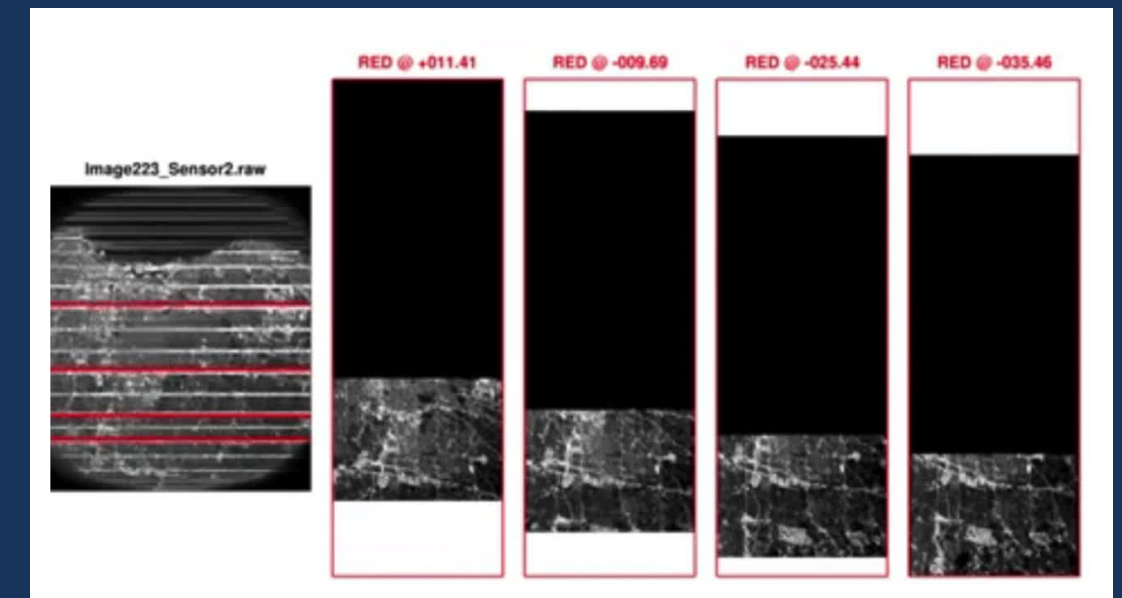
: DATA SOLUTIONS - SATELLITE DATA PROVIDER - SPECIFICATIONS

Specifications

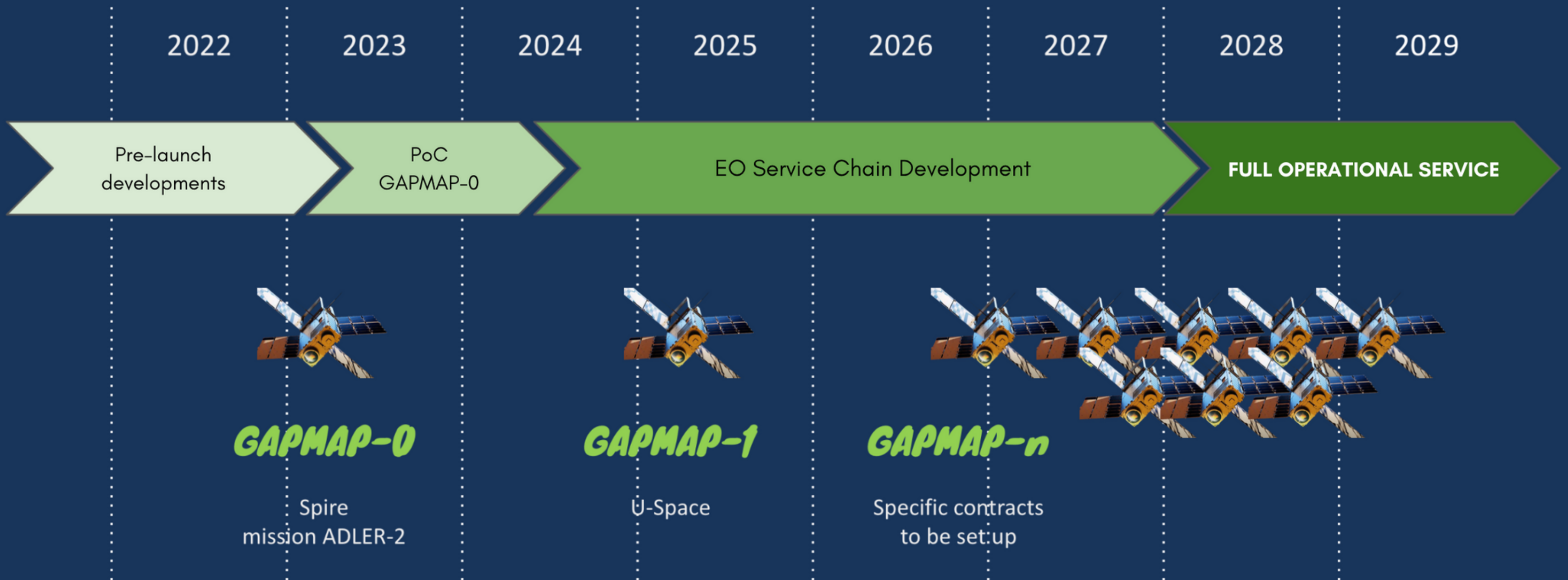
- 10 x Multi-Angle polarized measurement
- GAPMAP: Our own payload built based on NASA HARP Cubesat experience
- 1st launch: ADLER-2 mission, April 2023
- Revisit time: 5 times/day
- 4 wavelengths (440, 550, 670, 870nm)
- 3 linear Polarizations
- On-board calibrator
- Wide FOV (>1000 km)
- Hyper-Angular Sampling
- Size 2.5U
- Resolution 300m-2km

Applications

- Air quality PM 1, 2.5, 10
- Aerosol monitoring
- Weather forecasting
- Clouds properties
- Climate change
- Radiative forcing
- Surface retrieval:
 - > Precision agriculture (PA)
 - > Ocean color
 - > Other
- Emergency monitoring
- Volcano activity



: DATA SOLUTIONS: SATELLITE DATA PROVIDER - ROADMAP





Software solutions

: SOFTWARE SOLUTIONS - GRASP

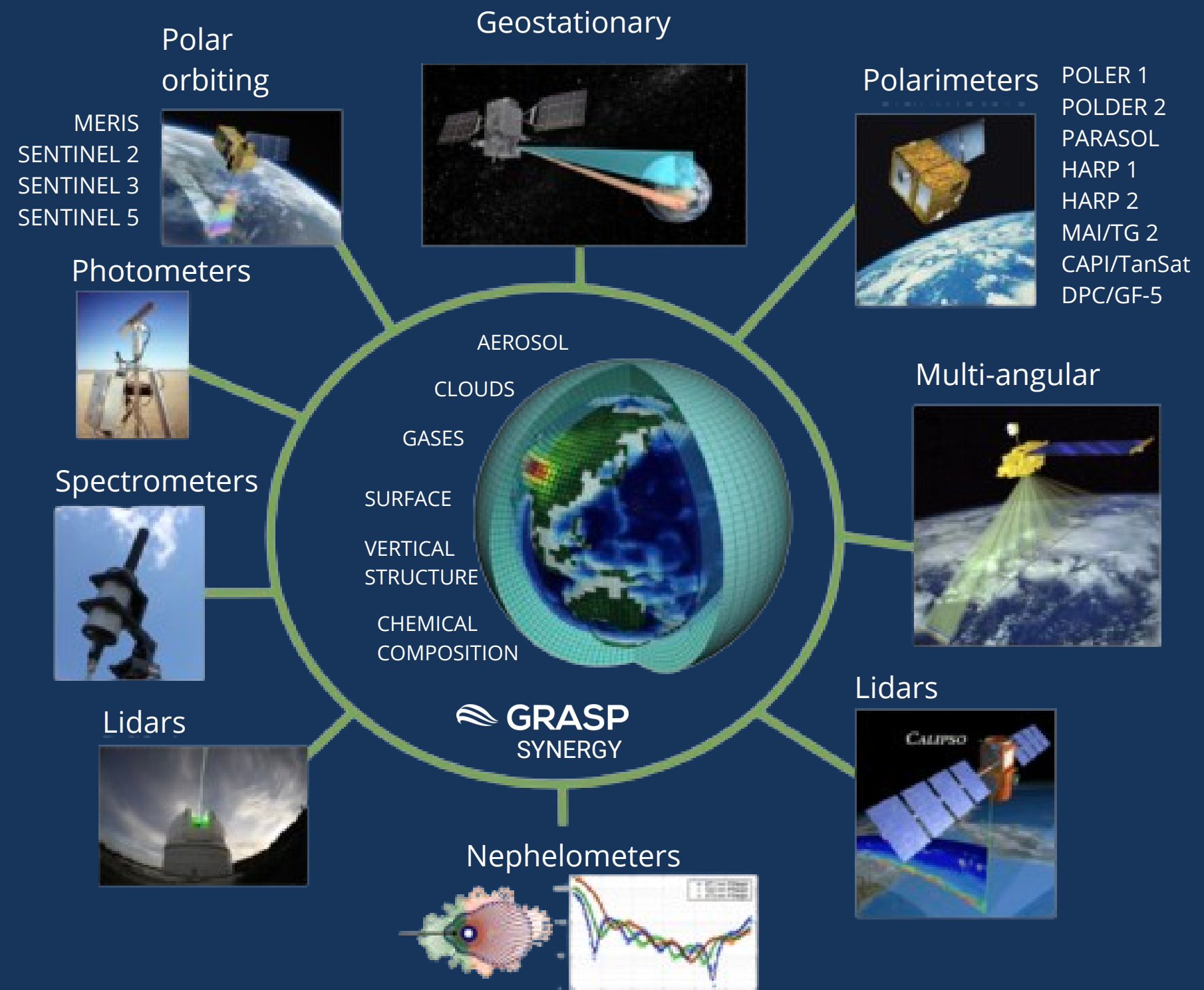
Description:

GRASP is one of the most advanced algorithms for the retrieval of aerosol, gas and surface properties from any remote sensing source and the combination of them.

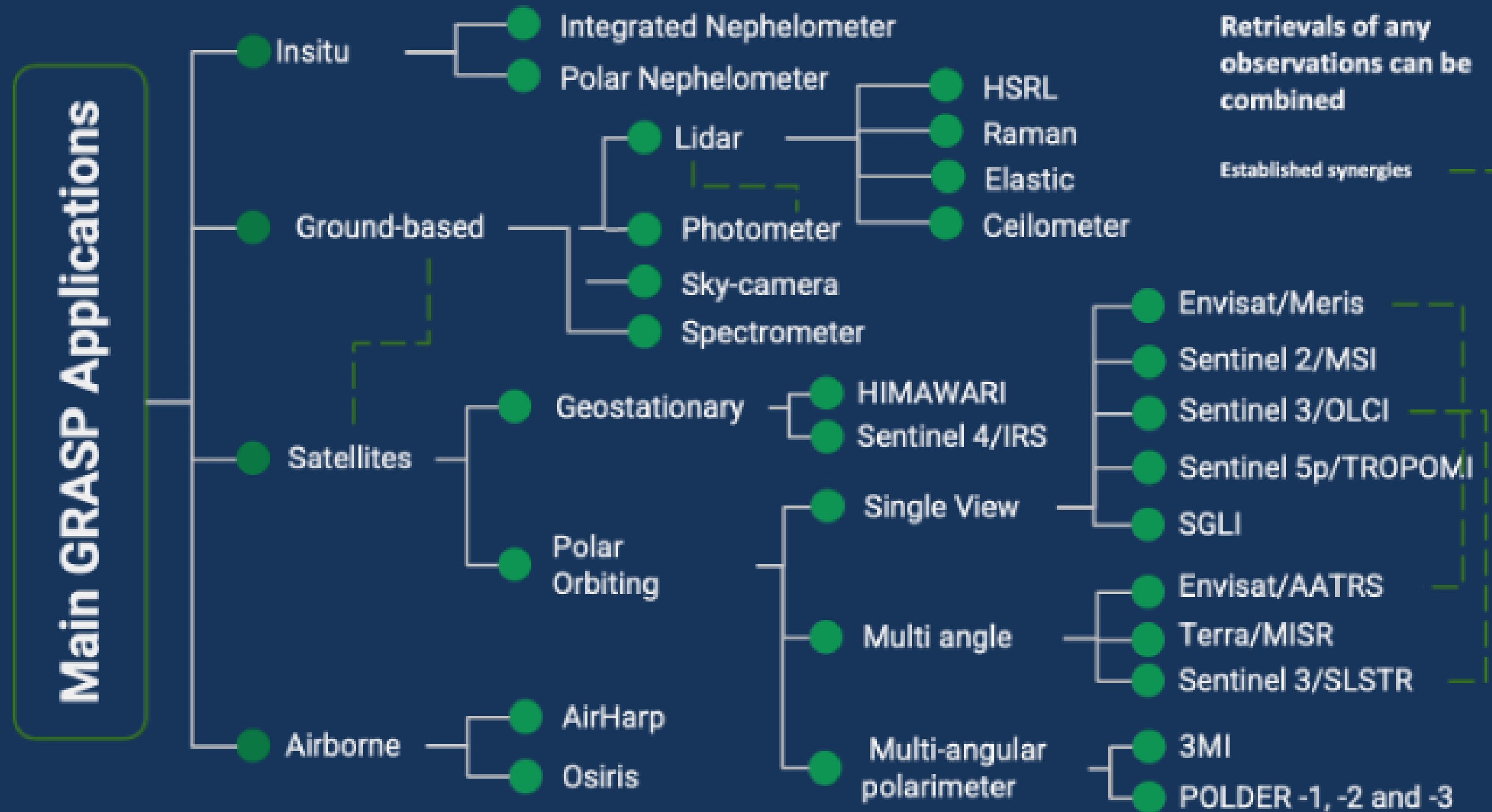
It is currently used by main spatial agencies worldwide and was subject of over 80 scientific publications in the last decade.

It has a multi-pixel approach with 2 extra constraints: aerosols have limited horizontal variability; surface properties change slowly with time.

It is based on AERONET heritage, a worldwide network of over 200 radiometers run by NASA that are acknowledged as highly-valued aerosol products in a very large number of scientific publications.



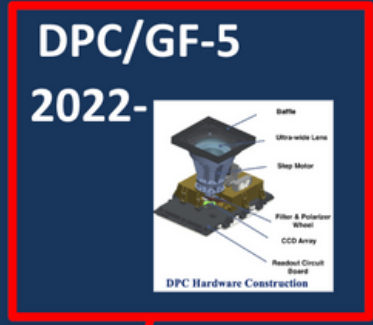
: SOFTWARE SOLUTIONS - GRASP



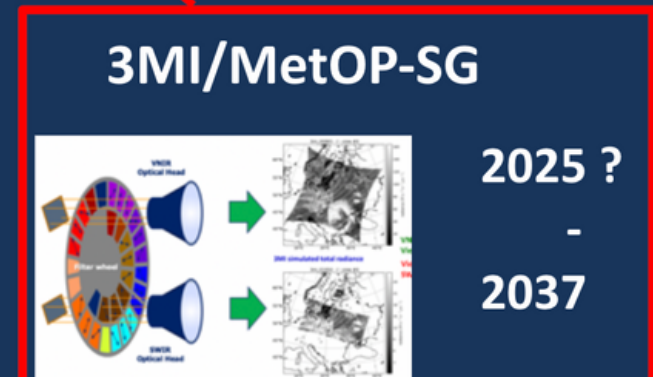
: SOFTWARE SOLUTIONS - SPACE



GRASP aerosol and surface product developments



MAP – Multi – Angular Polarimeters



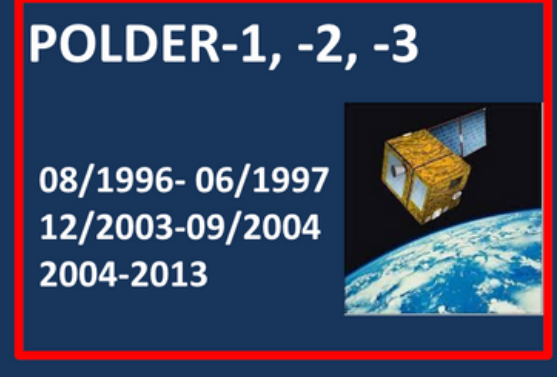
Past mission



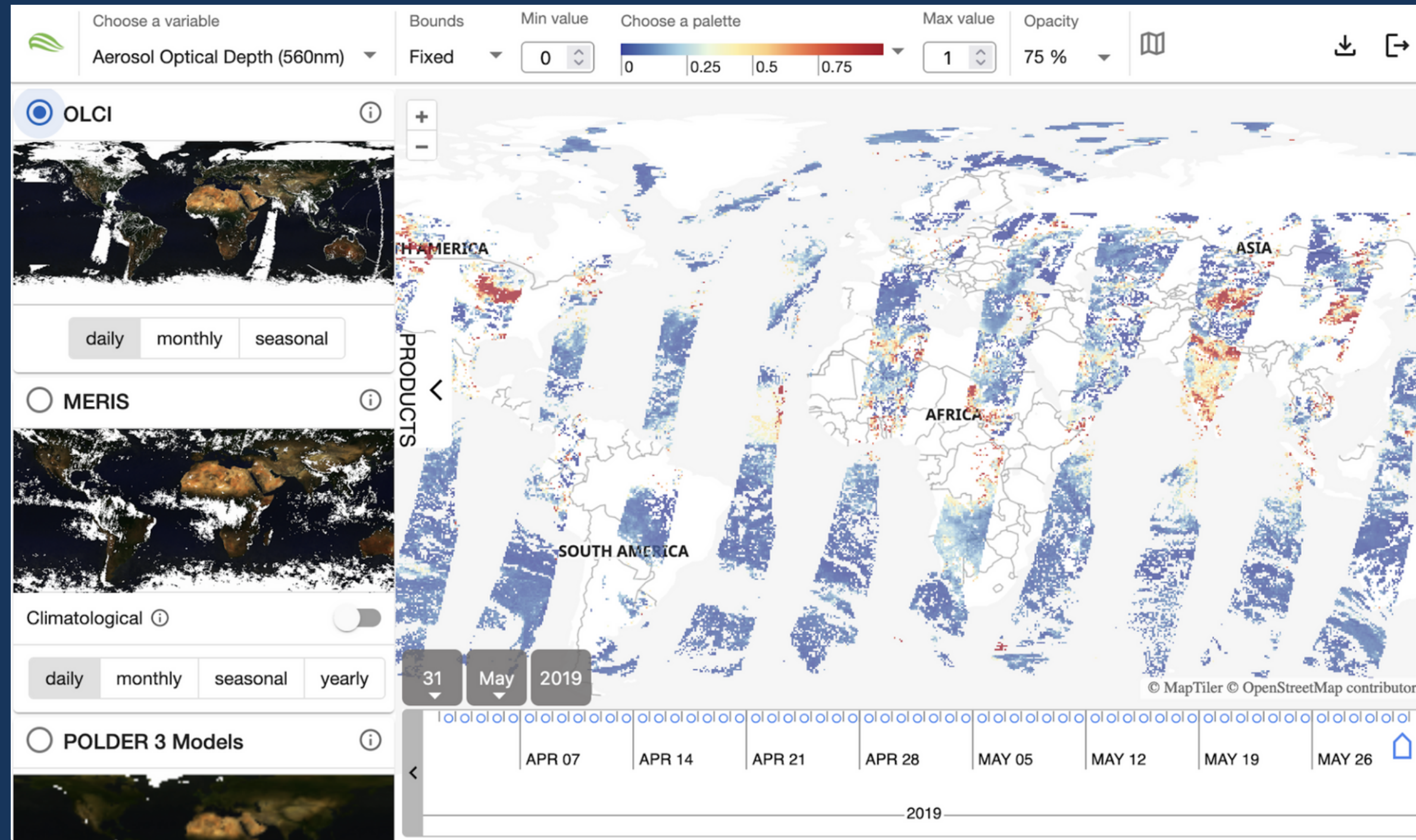
Copernicus Sentinel missions

Sentinel	Instrument	Launch Date	Year
S-1	Radar	3 Apr. 2014	2014
S-2	High Resolution Optical	23 Jun. 2015	2015
S-3	Medium Resolution Optical & Altimetry	16 Feb. 2016	2016
S-4	Atmospheric Chemistry (GEO)	2021	2021
S-5P	Atmospheric Chemistry (LEO)	13 Oct. 2017	2017
S-5	Atmospheric Chemistry (LEO)	2021	2021
S-6	Altimetry	2020	2020
S-7	Candidate CO ₂ Monitoring Mission	envisaged 2025	2025

Past mission



: SOFTWARE SOLUTIONS - SPACE



: SOFTWARE SOLUTIONS - GROUND

Characterization of Aerosol properties over KAUST using GRASP algorithm:

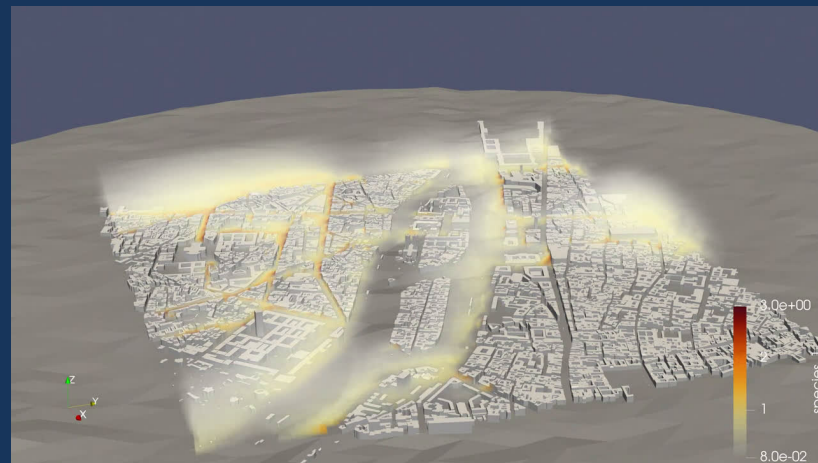
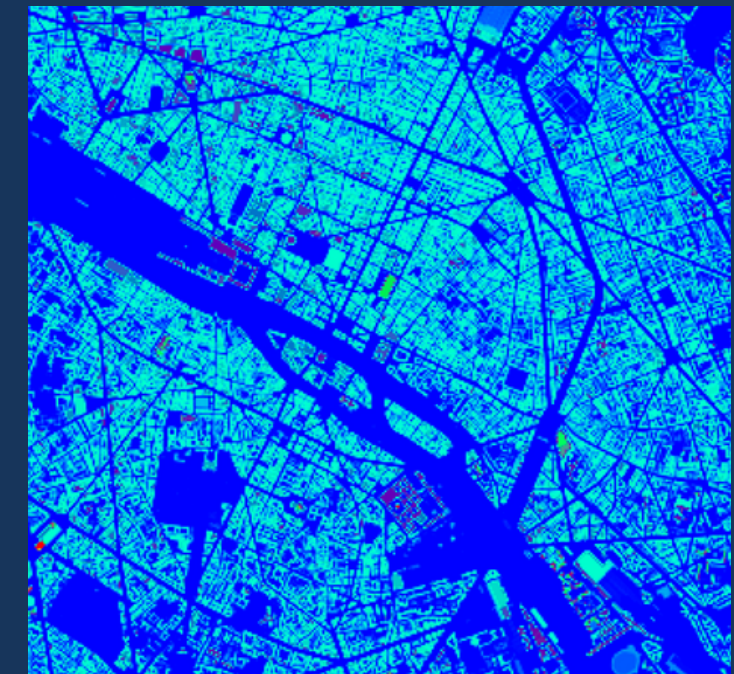
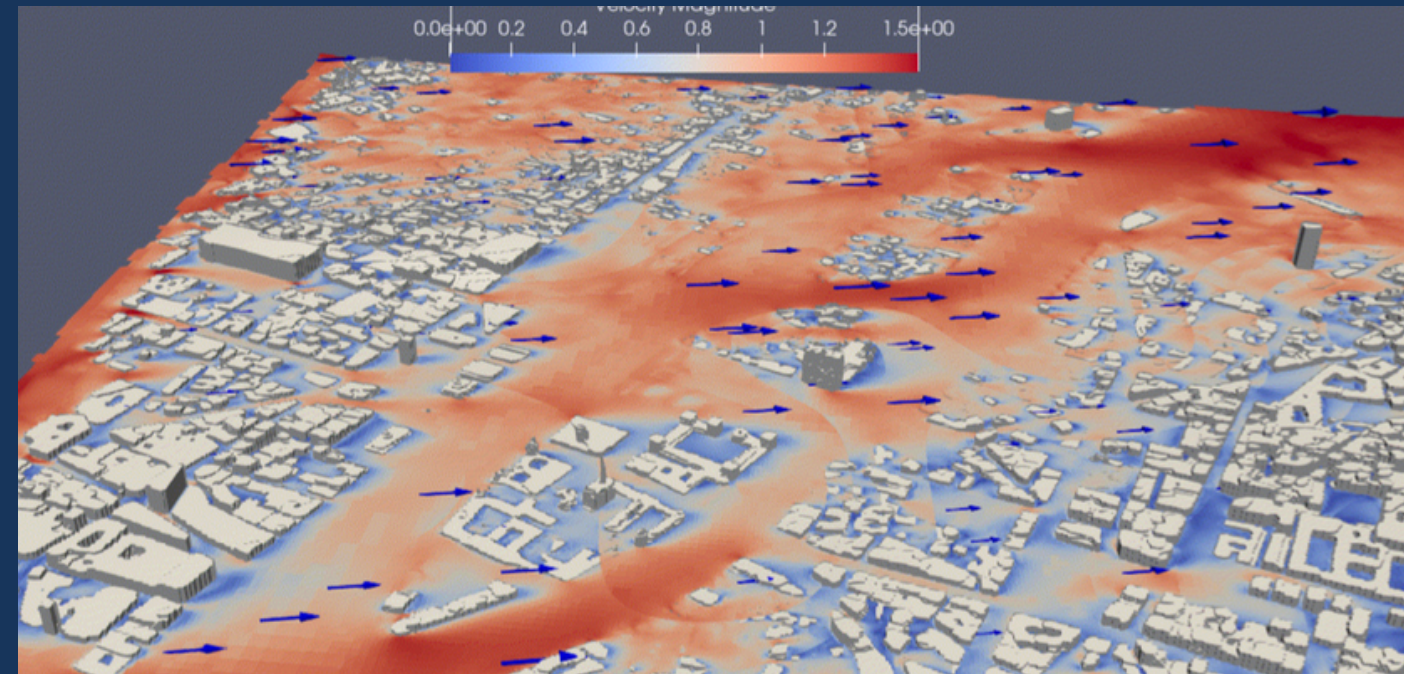
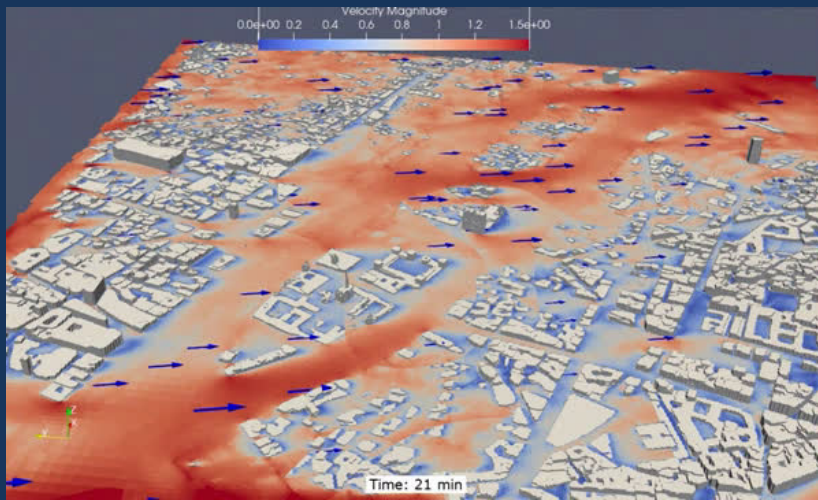
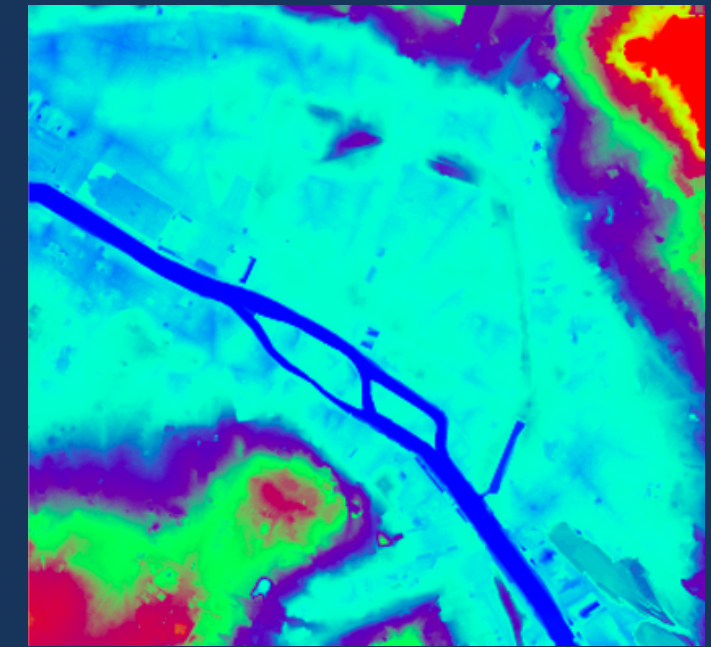
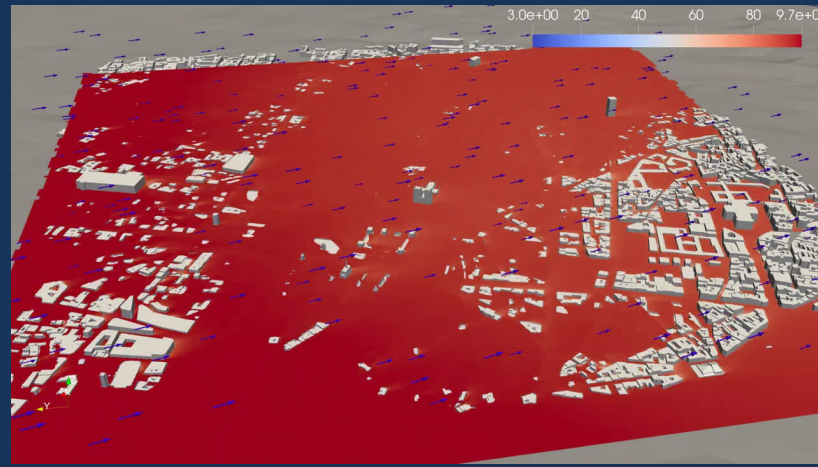
Synergy processing of diverse ground-based remote sensing and in situ data using the GRASP algorithm: applications to radiometer, lidar and radiosonde observations

The project provided advanced analysis of aerosol vertical structures as well as its columnar averaged properties, such as size shape and chemical composition using a synergetic combination of lidar and sunphotometer data. Extensive time continuous observations and application of state-of-the-art multi-temporal inversion technique realised in GRASP allowed to analyse diurnal and seasonal variability of these properties over KAUST observation site.



Read more.pdf

: SOFTWARE SOLUTIONS - MODELLING

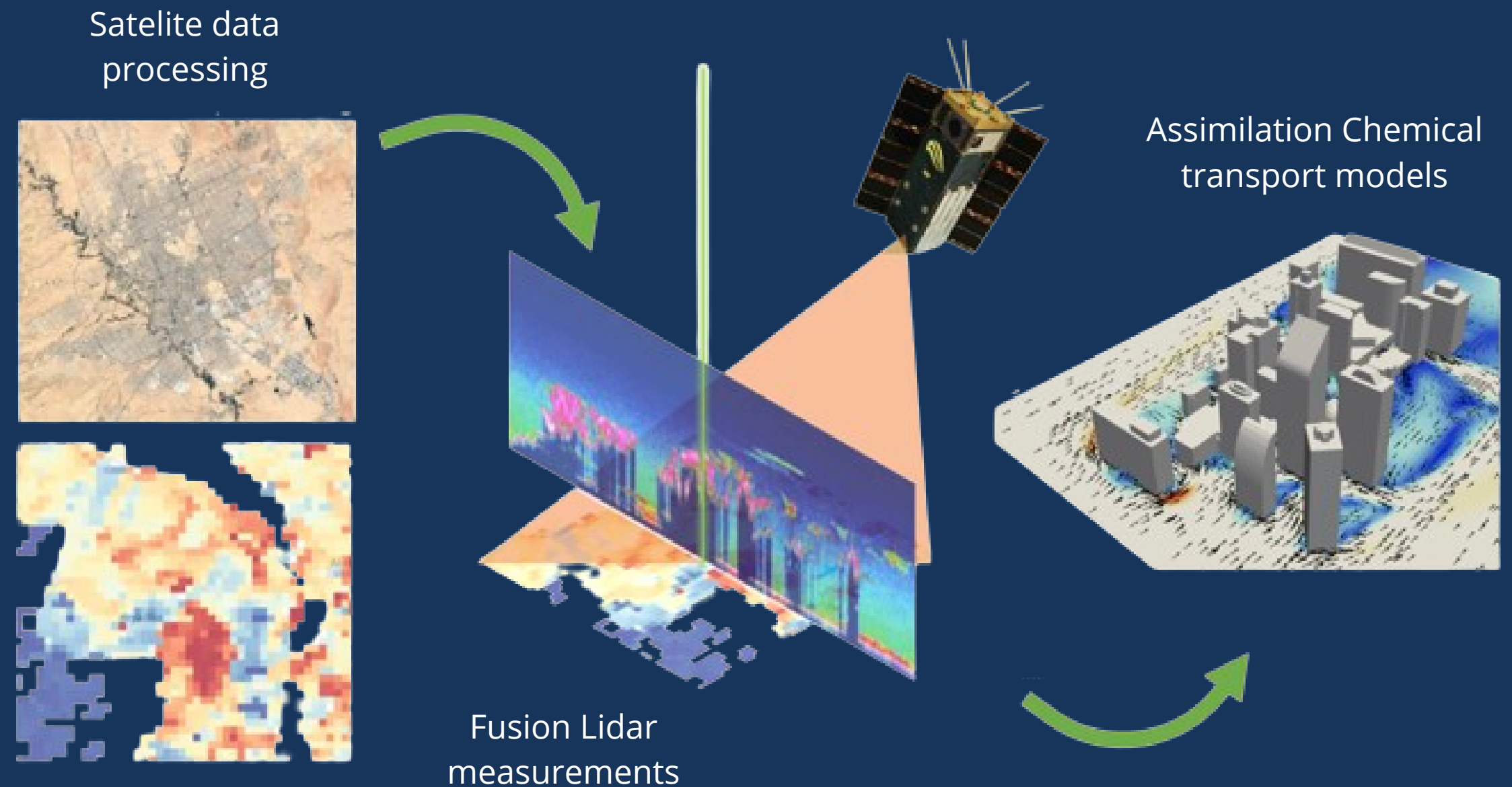


: SOFTWARE SOLUTIONS - SYNERGIES

We can envision a sophisticated system that integrates satellite observations with a ground-based network of remote sensing and in-situ instruments.

When coupled with intricate air mass transport simulations, this system can offer an advanced **synergetic** approach based on GRASP, providing ample data to estimate the complex movements of air pollutants within a specified region, such as a city.

This estimation goes beyond just surface-level tracking and extends to vertically resolved atmospheric layers. This approach allows for information to be available over a much wider area than what a ground-based system alone could cover, effectively bridging temporal and spatial data gaps.





Ground solutions

: NEPHELOMETERS - IN101

Descripton:

IN101 3-wavelength Integrating Nephelometer is enclosed in an environmentally protected case, ready for outdoor deployment in rugged conditions.

Power requirements are 40W @ 120 VC (60W Max) and input power options include: 110/240 VAC,50/60Hz with provided power supply, and regulated 12VDC from sampling station with provided power connector. Other powering options can be made available upon request such as operating from batteries or solar power. Optional heaters are available at the expense of additional power consumption.

Data from the AirPhoton IN101 Integrating Nephelometer is saved in a removable SD memory card and can be linked to an external computer via RS485 or wirelessly via Bluetooth.

Specifications:

Dimensions: 9" x 10" x 24"

Mass: 6.7 Kg

Operating temperature: -30 to +45oC

Wavelengths: 450, 532, and 632 nm

Angular range: 7 to 90o ; 90 to170o

Full scattering = forward + back scattering

Standard range: 0.0-3,000Mm-1

Extended range: 20,000Mm-1 (upon request)

Lower detectable limit: <0.15 Mm-1 (at 60 sec AVG) < 0.06

Mm-1 for Backscattering (60 sec AVG)

Clean air reference option provides automatic zero for span calibration

Data Interfaces: 4GB SD card, RS485 (optional)

: NEPHELOMETERS - IN102 SIZE SCANNING

Descripton:

IN102 Size Scanning Nephelometer lets you select the size of aerosol you wish to sample in the range from PM2.5 to PM10. Our feedback flow control system makes this possible. We use a sharp cut off cyclone inlet a custom made smart blower (fan) and carefully monitor and adjust the flow rate to achieve this versatility.

Power requirements are 40W @ 120 VAC (60W Max) and input power options include: 110/240 VAC,50/60Hz with provided power supply, and regulated 12VDC from sampling station with provided power connector.

Data from the AirPhoton IN102 Scanning Nephelometer is saved in a removable SD memory card and can be linked to an external computer via RS485 or wirelessly via Bluetooth.

Specifications:

Dimensions: 9" x 10" x 24"

Mass: 6.8 Kg

Operating temperature: -30 to +45oC

Wavelengths: 450, 532, and 632 nm

Angular range: 7 to 90o ; 90 to170o

Full scattering = forward + back scattering

Standard range: 0.0-3,000Mm-1

Extended range: 20,000Mm-1 (upon request)

Lower detectable limit: <0.15 Mm-1 (at 60 sec AVG) < 0.06

Mm-1 for Backscattering (60 sec AVG)

Clean air reference option provides automatic zero for span calibration

Data Interfaces: 4GB SD card, RS485 (optional)

: NEPHELOMETERS - IN102EX EXTENDED RANGE SIZE SCANNING

Descripton:

IN102Ex Size Scanning Nephelometer extends the capabilities of our IN102 nephelometer aerosol to sample in the range from PM1 to PM10.

The additional range of the measurements allows us to derive the full particle size distribution. We use the same feedback flow control system as described above for the IN102.

IN102Ex Retrieves Aerosol Size Distribution

We are very proud to be able to demonstrate the capability of our IN102 Extended range nephelometer to retrieve a full aerosol size distribution.

Specifications:

Dimensions: 9" x 10" x 24"

Mass: 6.8 Kg

Operating temperature: -30 to +45oC

Wavelengths: 450, 532, and 632 nm

Angular range: 7 to 90o ; 90 to170o

Full scattering = forward + back scattering

Standard range: 0.0-3,000Mm-1

Extended range: 20,000Mm-1 (upon request)

Lower detectable limit: <0.15 Mm-1 (at 60 sec AVG) < 0.06

Mm-1 for Backscattering (60 sec AVG)

Clean air reference option provides automatic zero for span calibration

Data Interfaces: 4GB SD card, RS485 (optional)

: NEPHELOMETERS - MODEL CR100 CLEAN AIR REFERENCE SYSTEM

Descripton:

Our Nephelometers are designed for stable and low noise operation. For more accurate operations a modular clean air reference system is available for separate purchase as an attachment to the Independence nephelometer models.

The CR100 clean air reference system is designed to compensate for potential calibration drift of the IN101 or IN102 nephelometer.

The CR100 pumps ambient air through a high quality HEPA filter that removes aerosol particles from the air to a level that the clean air can be used as a Rayleigh scattering reference for the nephelometer. The CR100 can be used as a semi-permanent attachment to the body of the nephelometer or as a portable bench top reference system.

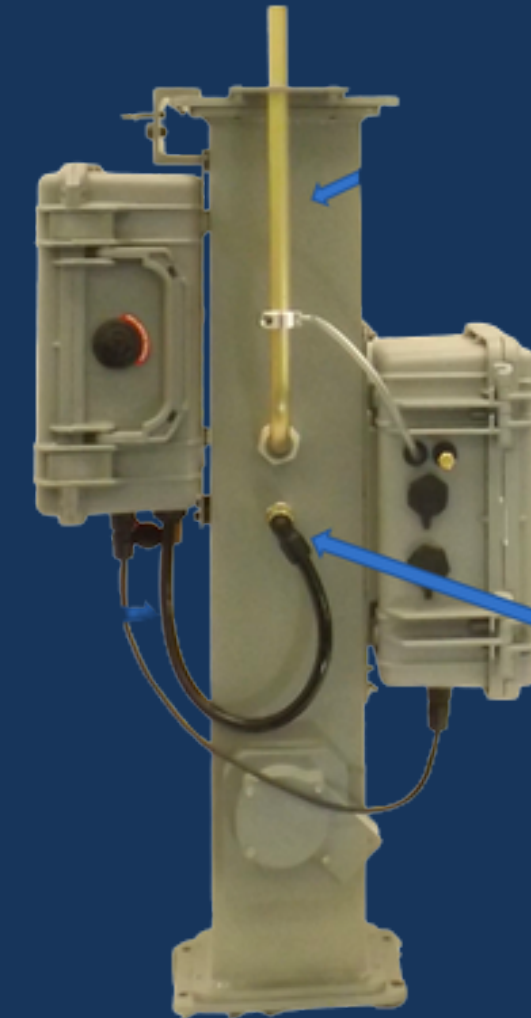


Image: CR100 system mounted on the body of a IN101 nephelometer.

: NEPHELOMETERS - COMPARISON

Model	Forward & Back Scatter Measurements	Three Wavelengths	High Speed Fan	Feedback Flow Control System	Multiple Size Bins	Determines Size Distribution	Suggested Uses
IN101	✓	✓					Measurements of all particle sizes at normal ambient conditions
IN101Turbo	✓	✓	✓				For situations where higher pressure intake is required: high altitudes, clean condition, or long inlet tubes.
IN102	✓	✓	✓	✓	✓		High precision measurements for various size cut-offs under all conditions for air quality & health and climate applications
IN102Ex	✓	✓	✓	✓	✓	✓	High precision measurements for various size cut-offs under all conditions for air quality & health and climate applications with ability to obtain size distribution.

: FILTER STATIONS - EXPLORER MODEL SS5I SINGLE INLET

Descripton:

The Explorer Model SS5I Single Inlet Unit employs a PM10 inlet designed to run at 5 liters per minute.

The flow rate can be adjusted by a manual valve in the Sampling Control Box.

An option exists to further separate PM2.5 and coarse mode ($2.5 < d < 10\text{mm}$) aerosols using Nuclepore® filter separation in our FC10 filter cartridge.

Other size selection combinations at the filter stage are possible upon request.

Specifications:

Box dimensions: 12.5" x 15" x 9"

Installed height: 40" but varies per configuration

Inlet option: Single

Flow rate: 5 lpm

Inlet size cut-off options: PM10, PM4, P2.5, or PM1

Cyclones inlets available for sharper cut-off

Optional second stage size separation using Nuclepore(R) filter equipped cartridge

: FILTER STATIONS - EXPLORER MODEL SS5I DUAL INLET

Descripton:

The Dual External Inlet is available in a variety of configurations. It is available as either a single or dual inlet design with options for PM10, PM4, PM2.5 and PM1 collection using impactors or cyclone inlets.

Specifications:

Box dimensions: 12.5" x 15" x 9"

Installed height: 40" but varies per configuration

Inlet option: Dual

Flow rate: 5 lpm

Cut-off options: PM10, PM4, P2.5, and PM1

Cyclones inlets available for sharper cut-off

Optional second stage separation using Nuclepore(R) filter equipped cartridge

Power inputs: 110/220 VAC 50/60Hz and nominal 12VDC.

Solar power compatible.

: FILTER STATIONS - FILTER CARTRIDGE MODEL FC10

Descripton:

The 8-slot filter cartridge is a unique design that holds and protects 8 particle sampling filters. This design minimizes the handling of the filters in the field and reduces the frequency of site visits by technicians.

Used in conjunction with the Explorer Automated Filter Sampling Station, the cartridge can be deployed through 8 sampling cycles (one of which can be a blank for reference) before exchange with a fresh cartridge is necessary. Each of the 8 slots can hold either 1 filter for straightforward measurements of particles of one size, or 2 sequential filters of different pore sizes for separation of particles by size.

Specifications:

When used with the dual inlet system and control box each inlet can be used separately for four sampling cycles. One filter location for each flow can be used as a reference blank.

- Dimensions: 3" x 6" x 1.25"
- Single or dual stage filtering
- Filter Diameter: 1"
- Weight: ~ 0.6 kg

: FILTER STATIONS - COMMUNICATIONS MODULE

Descripton:

The Communications Module allows remote communication with the instrument, user can script files to the instrument to change and modify sampling protocols. Users can also download operational status and house keeping information about the instrument. Works both on cellular and WiFi networks.

Specifications:

White box: 7" x 5" x 1.5"

Weight ~ .5 kg



Image: Components of the Communications Module

: POLAR IMAGING NEPHELOMETER

Descripton:

The Polar Imaging nephelometer is our most unique and highest-grade instrument that is only manufactured in a yearly build.

This robust, precise instrument has the unprecedented ability to measure aerosol light scattering and provide information on particle morphology in real-time.

Furthermore, it is able to classify aerosols by type such as dust, biomass burning, and biogenic aerosols.

This is a high grade custom-made instrument. Typical lead time is ~9 Months.

Learn more about the Polar Imaging Nephelometer through our publications [here](#).

Specifications:

Size Distribution and Complex Refractive Index
Full Particle Characterization
From Hyper-angle Scattering Measurements
Measures light scattering from 3° to 176 °
Angular resolution of less than 1°
Standard configuration is 2 Visible Wavelengths
Can be customized for 1 – 3 wavelengths
GRASPTM software analysis package
Retrieves size distribution, percent
Sphericity and complex refractive index

: INVERSE MULTI-ANGLE POLARIZATION POLARIMETER (IMAP)

Descripton:

The Inverse Multi-Angle Polarization Polarimeter (IMAP) measures scattering by particles as a function of:

- Scattering angle
- Wavelength
- Linear polarization

Each measurement type above is made in up to 4 distinct size-bins from PM1 to PM10.

Using the GRASP data retrieval software the IMAP will produce:

- A complete size distribution of the the measured particles every two minutes
- The real refractive index of the particles for each size distribution
- Particle mass

Specifications:

Angular ranges measured: 8

View angles centered at 5 °, 25.7 °, 51.4 °, 77.1 °, 102.8 °, 128.6 °, 154.3° and 170 °

Instantaneous field of view < 7.5°

Wavelengths: 3 470 nm, 529 nm and 621 nm

Polarization orientations: 2 Parallel and perpendicular to the scattering plane

Size measurements: 4 size bins ranging from PM1 to PM10

: SEALIDAR - LASER-INDUCED FLUORESCENCE (LIF) LIDAR

Descripton:

The system operates by discharging laser pulses into water, which then excite oil molecules. The resulting fluorescence is measured to determine the presence and concentration of oil in water.

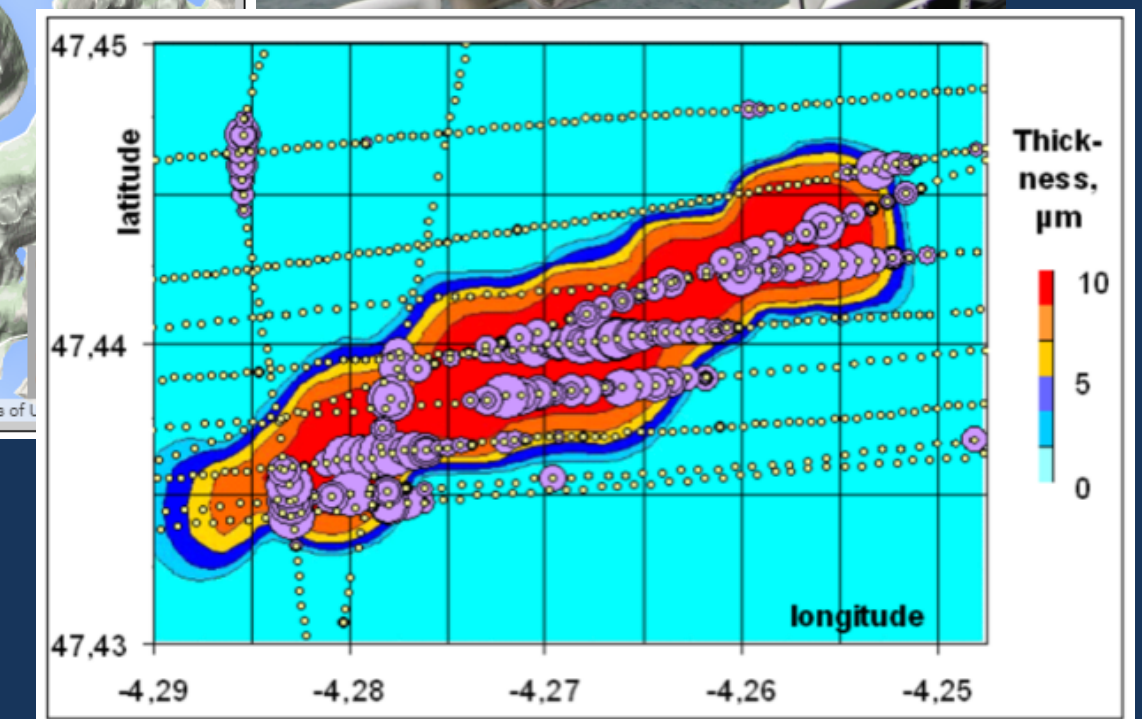
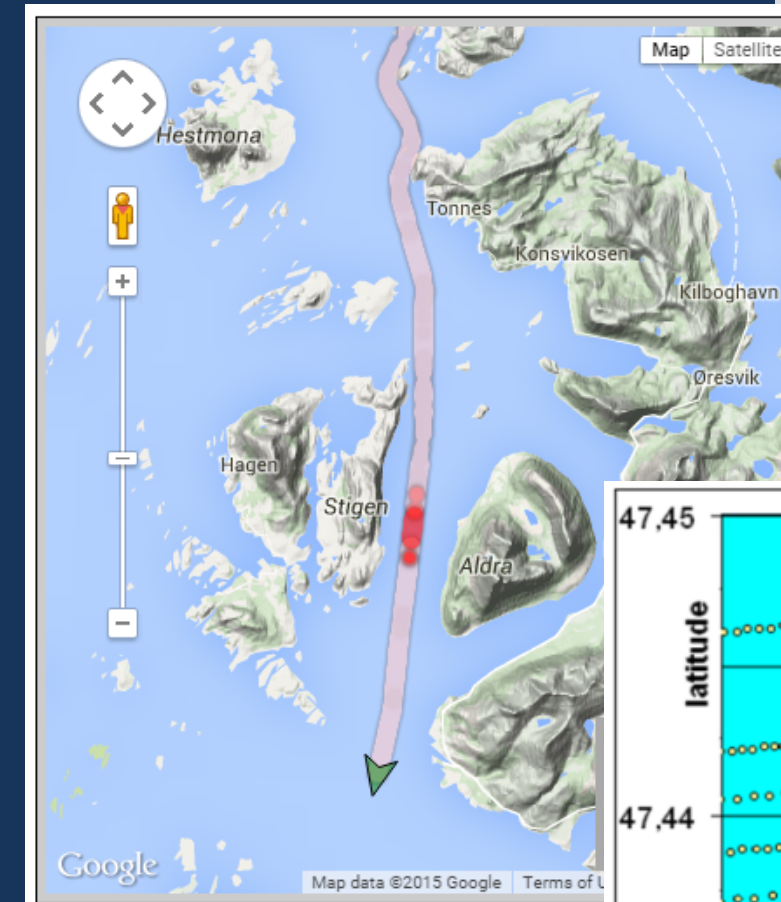
It is a spectroscopic method for detecting and measuring organic and inorganic substances. A laser excites molecules, which emit light at a specific, longer wavelength. This emitted light, unique to each substance, enables precise identification and quantification.



: SEALIDAR - LASER-INDUCED FLUORESCENCE (LIF) LIDAR

Capabilities:

1. Mobile oil pollution mapping from service vessels, patrol boats, and marine drones.
2. Detection and quantification of oil-in-water emulsions, uniquely as a remote measurement method.
3. High sensitivity starting from 1 ppm, with the capability to measure up to 10 times per second.
4. Real-time wireless data transmission to a data center for immediate oil leakage alerts.



: SEALIDAR - LASER-INDUCED FLUORESCENCE (LIF) LIDAR

Added values:

Accurate Detection:

LIF LiDAR technology provides precise and reliable detection of oil films on water surface and oil-in-water emulsion in the 3-5 m surface layer (up to 10 for open ocean).

Early Warning System:

The technology enables the detection of oil spills at an early stage, allowing for prompt response and mitigation measures.

Protecting Ecosystem:

Effective prevention and rapid response to oil spills are crucial for companies to preserve local ecosystems. These ecosystems often support vital services like fisheries and tourism, which, if damaged, can lead to extensive economic repercussions.

Protecting Company Reputation:

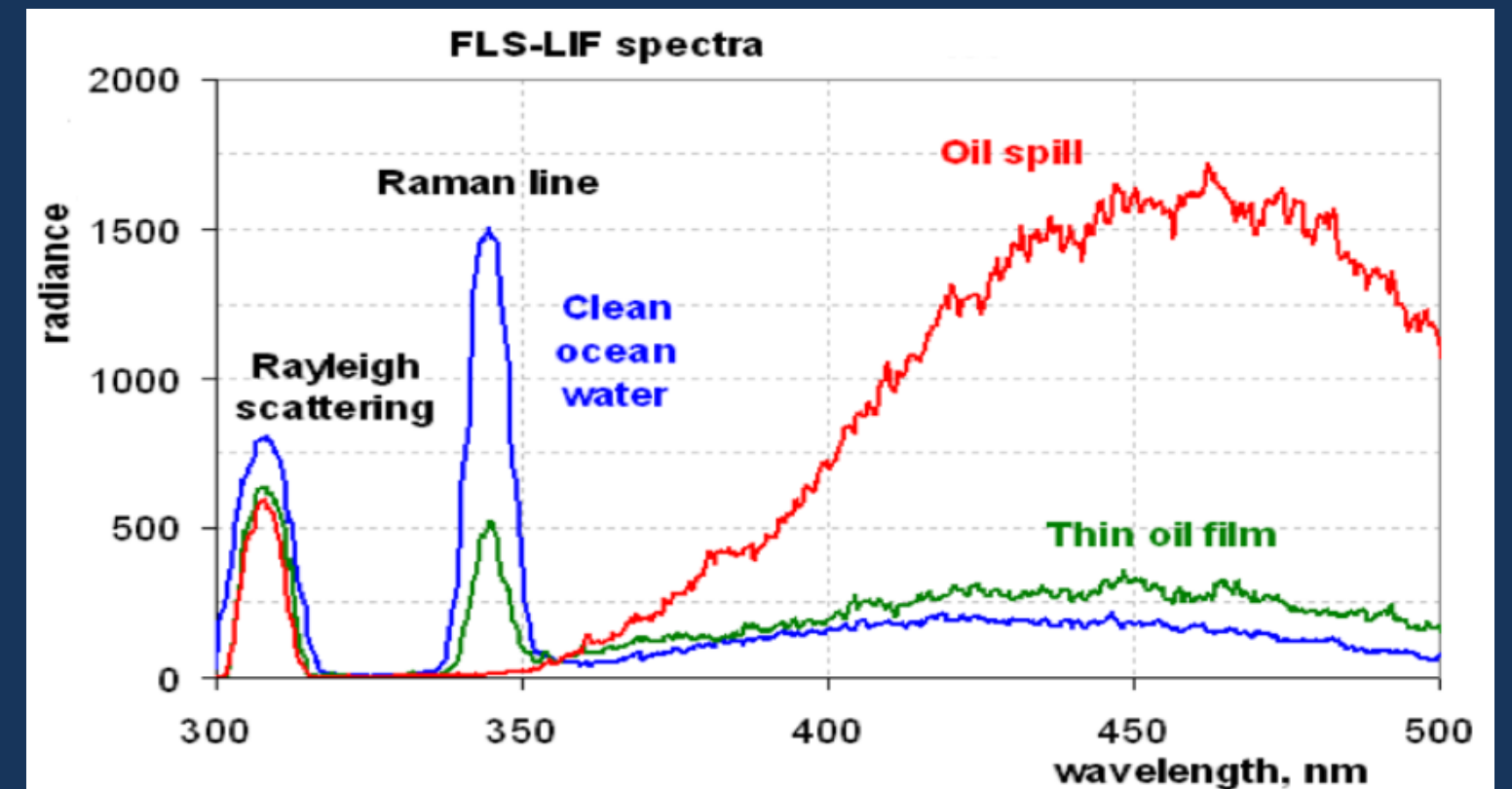
By effectively managing and quickly responding to oil spills, companies can avoid environmental damage, fines, and negative publicity, which can have long-term impacts on their brand value.

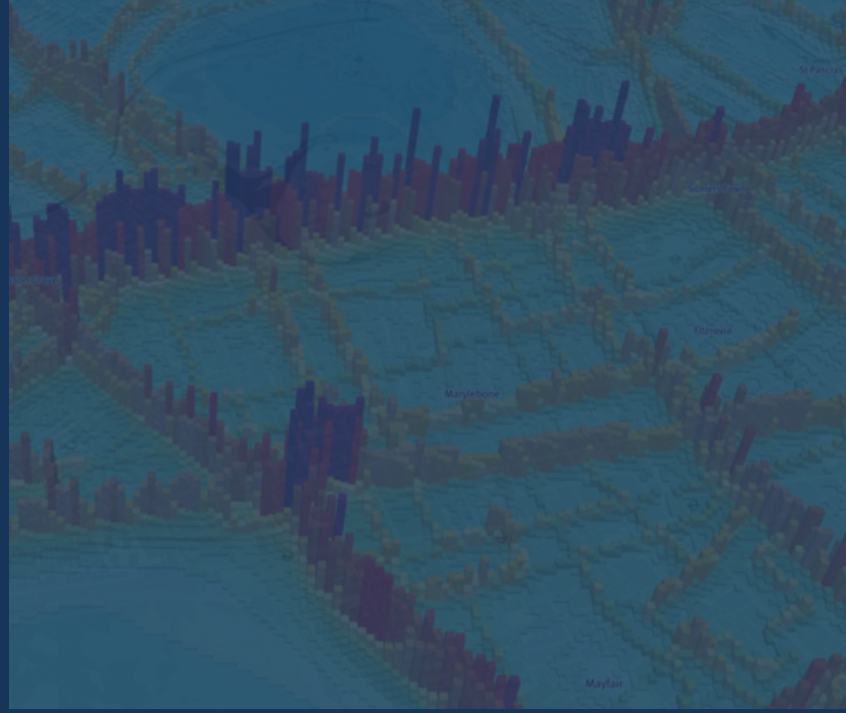
Rapid data acquisition and processing:

Allowing for real-time monitoring and quick response to oil contamination.

Cost-effective Solution:

LIF LiDAR technology offers a cost-effective solution for oil spill detection compared to conventional methods.






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